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Giant piezoelectric response in textured piezoceramics with tetragonal tungsten bronze structure

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High-density textured ceramics samples $K_2Sr_4Nb_{10}O_{30}$ with the large dielectric anisotropy were sintered by the hot-pressuring technique. Its crystallographic characteristics obtained by the X-ray powder diffraction method were analyzed and compared with the data for isotropic ceramics. Lattice parameters and relative uniform deformations were determined for crystallites which axes are oriented parallel (*c*-oriented) or perpendicular (*a*-oriented) relative to the texture axis. It was shown that a-oriented crystallites are under tensile deformations along the c-axis and compression along the a-axis without changing cell volume, while c-oriented crystallites are stretched along the a-axis with enlarged cell volume.

The amplitudes of the surface piezoresponse (PR) of the textured samples turned out to be abnormally large, which was not observed for an isotropic ceramics sample. The relative piezomodulus d_{33} were estimated from the PR magnitudes. It turned out to be ~(67-98) or ~(85-146) times greater (depending on the sample orientation relative to the texture axis) than for the isotropic sample. The piezomodules measured for bulk samples are in a similar ratio. One of the possible reasons of the giant surface PR can be attributing to the deformations anisotropy in the *a*- and *c*-oriented crystallites in textured ceramics. Because of this, the different types of crystallites have different lattice parameters. During the dense ceramics fabrication, an interface arises between different types of crystallites, on which the direction of the spontaneous polarization vector becomes less stable. It increases the sensitivity of the ceramics surface to an external electric field, which can greatly magnify the PR amplitude. Its value should depend on the sample orientation relative to the texture axis, in consistency with the difference in the estimated values of the relative d_{33} above. The possible influence of domain walls and polar nanoregions on the giant piezoelectric response in hot-pressed potassium-strontium niobate ceramic is discussed.

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